ET 43 - Electrician Theory Examination Marking Schedule

Notes: 1. (1 mark) means that the preceding statement/answer earns 1 mark.

2. This schedule sets out the accepted answers to the examination questions. A marker can exercise their discretion and decide on the overall accuracy of any answer that is presented in the candidate's own words.

3. Symbols and terms - alternatives

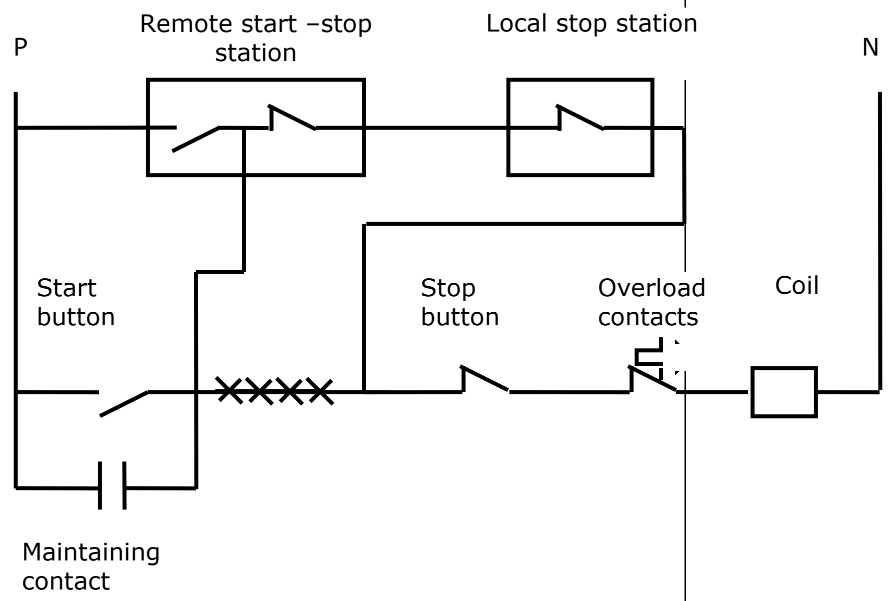
Power	W or P
Voltage	V or E or U
Phase	Active

Question 1	*Reference Marks*	*Marking notes*
(a) • Because of the current flow • Through the impedance of the windings.	(1 mark) (1 mark)	
(b) The power will vary by the square of the change in voltage	(2 marks)	**The effect can be explained by using calculations**
(c) Under fault conditions, it prevents the voltage between the frame of the appliance and earth from rising above near 0 volts	(2 marks)	
(d) Any ONE of: • Change the phase sequence on the incoming supply • Interchange two phases on the motor terminal block	(2 marks)	
(e) Any ONE of: • If the motor was starting, it would not rotate. • If the motor was running, it would stall.	(2 marks)	
(f) To verify that the kA rating of the protective devices are capable of safely interrupting the prospective short circuit current.	(2 marks)	
(g) To verify that the final subcircuit protective device will operate in the required time under fault conditions.	(2 marks)	
(h) Any ONE of: • The protective device must be capable of	(2 marks)	

Question 1	*Reference Marks*	*Marking notes*
safely clearing that level of prospective short-circuit current without damage. ● To ensure the protective device can operate within the minimum permitted time.		
(i) ● As current through the HRC fuse increases ● The time taken to operate decreases.	(1 mark) (1 mark)	
(j) Any TWO of: ● In double-tube fittings, a capacitor connected in series with one ballast. or Install lead/lag fittings ● Incandescent lighting is interspersed with the fluorescent lighting. ● Install electronic ballasts	(2 marks)	

Question 2	*Reference Marks*	*Marking notes*
(a) (i) ● Voltage	(½ mark)	
● Frequency	(½ mark)	
(ii) A Rectifier	(½ mark)	
B Smoothing circuit (d.c. link)	(½ mark)	
C Any ONE of: ● Inverter ● d.c. to a.c. Converter	(½ mark)	
D Control unit	(½ mark)	
(iii) Changes the d.c. supply back to a three-phase a.c. supply	(1 mark)	
(iv) The motor would overheat as there would be minimal fan cooling at low speed.	(1 mark)	
(b) Any THREE of: ● Easier to control the starting current ● Easier to control the starting torque ● Multiple variations of the time it takes from rest to full speed (or full-load torque. ● Reduces mechanical shock to equipment ● More even torque ● Less disruption on supply voltage	(3 marks)	
(c) To prevent both star and delta contactors operating simultaneously.	(2 marks)	

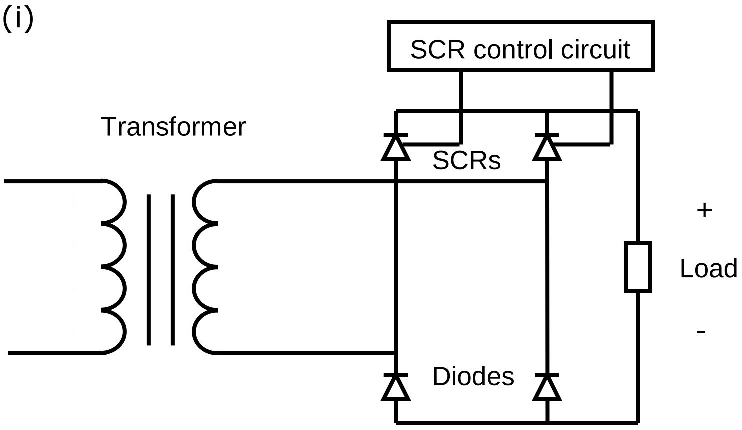
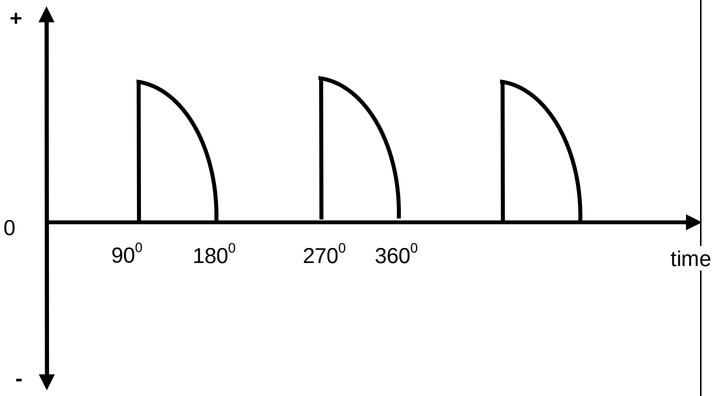
Question 3	*Reference Marks*	*Marking notes*
(a) (i) Any TWO of: ● The voltage to earth on any part of the installation is limited to 230V. ● The voltage potential between neutral and earth is about 0V. ● The low impedance main neutral ensures protective devices operate effectively.	(2 marks)	
(ii) Any TWO of: ● The high fault current increases the risk of fire through any high resistance joint. ● There is sometimes no indication that the installation main neutral is open-circuited ● A phase/neutral transposition on the mains. ● Removal of the MEN link ● Not installing the MEN link	(2 marks)	
(b) A MEN switchboard	(½ mark)	
(c) ● At the star point of the distribution transformer	(½ mark)	
● One (at least) on the distribution neutral.	(½ mark)	
● At each electrical installation	(½ mark)	
(d) Any TWO of: ● Capacity (kVA) of the supply source ● The impedance of the earth fault loop. ● Impedance of the mains.	(2 marks)	
(e) Any ONE of: ● There is supplementary insulation between the basic insulation and any metal that could become live under fault conditions. ● It would negate the safety design of the appliance.	(2 marks)	

Question 4	*Reference Marks*	*Marking notes*
(a)  P Remote start –stop station Local stop station N Start button Stop button Overload contacts Coil Maintaining contact • Working circuit with three conductors	(2 marks)	
(b) The motor will attempt to start direct on line.	(2 marks)	
(c) (i) Eff. = $\frac{\text{output}}{\text{input}}$	(½ mark)	
Output = input x eff.		
= 9.52 x 0.84	(½ mark)	
= 8 kW	(1 mark)	
(iii) P = $\sqrt{3} \times V_L \times I_L \times pf$	(½ mark)	
pf = $\frac{P}{\sqrt{3} \times V_L \times I_L}$		
= $\frac{9520}{\sqrt{3} \text{ X } 400 \text{ X } 16.96}$	(½ mark)	
= 0.81	(1 mark)	
(iii) kVA = $\frac{kW}{pf}$	(½ mark)	
= $\frac{9.52}{0.81}$	(½ mark)	
= 11.75 kVA	(1 mark)	

Question 5	*Reference Marks*	*Marking notes*
(a) The procedure has to cover: • Disconnecting the fixed wired appliances • Testing each appliance in turn • Selecting the insulation resistance function • Selecting the 250V or 500V range • Testing between phase and neutral • Less than 5Ω for the fault	(1 mark) (1 mark) (½ mark) (½ mark) (1 mark) (1 mark)	A procedure using an ohmmeter is an alternative approach
(b) The procedure has to cover: • Disconnecting the final sub circuit at the switchboard • Selecting the insulation resistance function • Selecting the 500V range • Testing between phase and neutral • Less than 5Ω for the fault	(1½ marks) (½ mark) (1 mark) (1 mark) (1 mark)	0 marks are awarded if the MEN link is removed to allow testing A procedure using an ohmmeter is an alternative approach

Question 6	Reference Marks	Marking notes
(a) (i) The protective earthing conductor test is carried out before the insulation resistance test	(1 mark)	
(ii) Any ONE of:		
Test 1		
The protective earthing conductor test has to show:		
● The use of an ohmmeter	(1 mark)	
● Testing between the PEC conductor of the flexible cord and the frame of the motor	(1 mark)	
● A test result of 1Ω or less	(1 mark)	
Test 2		
The insulation resistance test has to show:		
● The use of an insulation resistance tester	(½ mark)	
● A test voltage of 500V d.c.	(½ mark)	
● Testing between each conductor of the flexible cord and the frame of the motor.	(1 mark)	
● An test result of 1 MΩ or more	(1 mark)	
(b) The sequence has to show:		
● Ensuring the isolator is in the off position	(½ mark)	
● Checking that the DOL starter is isolated using the prove-test-prove method.	(1 mark)	
● Attaching a danger tag to the isolator.	(½ mark)	
● Locking the isolator in the off position	(1 mark)	
(c) The description has to show:		
● Using an ohmmeter	(½ mark)	
● Testing between an earth not associated with the motor final subcircuit	(½ mark)	
● And the frame of the motor	(1 mark)	
● Any ONE of: * An expected result of 1Ω or less. * A result that ensures the protective device will operate within the required time.	(1 mark)	

Question 7	*Reference Marks*	*Marking notes*
(a) Sec V_{PH} = $\frac{\text{Pri } V_L}{N_P}$	(½ mark)	
= $\frac{11000}{43.3}$	(½ mark)	
= 254 V	(1 mark)	
(b) Sec. VL = VPh x $\sqrt{3}$	(½ mark)	
= 254 x $\sqrt{3}$	(½ mark)	
= 440 V	(1 mark)	
(c) Pri. I_L = $\frac{\text{kVA}}{\sqrt{3} \times \text{Pri. } V_L}$	(½ mark)	
= $\frac{150000}{\sqrt{3} \times 11000}$	(½ mark)	
= 7.87 A	(1 mark)	
(d) Sec. I_L = $\frac{\text{kVA}}{\sqrt{3} \times \text{Sec. } V_L}$	(½ mark)	
= $\frac{150000}{\sqrt{3} \times 440}$	(½ mark)	
= 196.83 A	(1 mark)	
(e) Any ONE of: • Natural air convection and oil immersion • Natural air convection • Oil immersion	(2 marks)	

Question 8	*Reference Marks*	*Marking notes*
(a) (i)  SCR control circuit Transformer SCRs + Load - Diodes		***There are three other variations for connecting the SCR control circuit***
• Correctly connected transformer	(1 mark)	
• Correctly oriented diodes	(1 mark)	
• Correctly connected SCR control circuit.	(1 mark)	
• Correctly connected load	(1 mark)	
• Working circuit	(1 mark)	
(ii) 		
• Correct waveform shape	(2 marks)	
(b) Any ONE of: • Inductor • Capacitor • Resistor	(1 mark)	
(c) Any ONE of: • The current drops to zero • The current drops to less than holding current • Remove anode to cathode voltage.	(2 marks)	

Question 9	*Reference Marks*	*Marking notes*
(a) (i) Where there is a possibility of personal danger through the supply being restored.	(1 mark)	
(ii) Where equipment is faulty or damaged and using that equipment would cause damage or injury.	(1 mark)	
(iii) Any TWO of: ● Make sure the correct isolating switch is tagged. ● Make sure the switch is in the “OFF” position before it is tagged ● Fasten the Danger Tag securely so that it will not come off. ● Test to ensure isolation has taken place. ● Appropriate details are entered on the tag	(2 marks)	
(b) “Isolated” means that the motor has been: ● deliberately disconnected from the electricity supply and	(1 mark)	
● precautions taken to prevent reconnection	(1 mark)	
● “Switched off” means that the electricity ceases to be supplied to the motor	(1 mark)	
(c) ● The test instrument is checked to be operating correctly on a known live source. ● The equipment is tested to confirm (or otherwise) that it is isolated. ● The test instrument is again checked on a known live source to ensure is still operates correctly.	(1½ marks)	
(d) Any ONE of: ● Test between each phase and earth. ● Test between each phase and neutral.	(1 mark)	
(e) To allow stored energy to be dissipated	(½ mark)	